Grid Interface Architecture for Power Conversion
Technology #16232

Applications

Connecting electronic devices to the AC distribution system is a well understood task, and significant work has been completed in both sourcing power from, and delivering power to the grid. Applications of this technology include AC-DC conversion and LED lighting in commercial and residential applications.

Problem Addressed

The common method to achieve a high power factor is to cascade a power factor correction rectifier and a DC-DC converter. A boost converter is typically used in this process because it has a high power factor capability of about 0.99. However, with a boost converter, high voltage stress is applied to the components in the circuit, consequently reducing the overall efficiency. The buck converter, an alternative to the boost converter, has less voltage stress but the active components must still be operated directly from the AC line voltage, and hence require high voltages. This high voltage requirement results in low efficiency and low power density. A high power factor is desired to reduce transmission losses and improve the overall voltage regulation at the load. Moreover, a high power factor improves the stability and efficiency of the transmission network. By using a power conversion circuit that is capable of regulating and combining converter topologies, this technology decreases the voltage stress of the active and passive devices within the converter. This configuration allows for reliable power converters with high-frequency operation capabilities that are able to achieve a high power factor.

Technology

This technology improves power conversion by modifying the circuit architecture and allowing for a means to achieve sufficient power factor. The circuit architecture is characterized by a line-frequency rectifier, stack of capacitors, a set of regulating converters, and a power-combining converter. The rectifier connects the grid voltage to the capacitor stack while the capacitor stack allows for a high power factor in the power converter. The converters provide the total energy transfer needed by modulating the current drawn from the capacitor stacks and transferring the current to the line-frequency rectifier. The regulating converters regulate the outputs to allow for very high frequency operation with high efficiency and low device voltage stress, and the power-combining converter draws energy from the regulating converter outputs and delivers the combined power to the converter system output.

Advantages

- Increases device lifetime
- Increases overall efficiency
- Allows for substantial minimization
Categories For This Invention:

Electronics & Circuits
Power Conversion
Energy
Electric Vehicles
Transportation
Power Converters

Intellectual Property:

Method and apparatus to provide power conversion with high power factor
Issued US Patent
9,660,520

Inventors:

David Perreault
David Otten
Seungbum Lim

Publications:

Pushing the Envelope in Power Electronics
ILP Institute Insider
August 4, 2014
A Merged Two-stage Power Conversion Architecture with Switched Capacitor Circuit for an LED Driver Module
Doctoral dissertation
2012

External Links:

Power Electronics Research Group
http://www.rle.mit.edu/per/

Image Gallery: